

The present invention as set forth in claim 1 is directed to a crimped carbon fiber having a multilayer structure comprising an inner layer part and an outer layer part with a hollow structure in the inside thereof, the inner layer part having a carbon structure containing a herringbone structure, the outer layer part having a carbon structure differing from the carbon structure of the inner layer part.

The present invention as set forth in claim 2 is directed to a crimped carbon fiber having a multilayer structure comprising a center part and an outer layer part outside the center part with no hollow structure inside thereof, the center part having a carbon structure containing a shape that carbon layers vertical to the carbon fiber axis are stacked, the outer layer part having a carbon structure differing from the carbon structure of the center part.

The present invention as set forth in claim 11 is directed to a method for producing a crimped carbon fiber claimed in claim 9, which is a crimped carbon fiber according to claim 1, and wherein the carbon fiber is a vapor grown carbon fiber. The method comprises contacting a carbon source and a catalyst source with a sulfur source in a heating zone to produce a vapor grown carbon fiber, wherein the ratio of the molar number of sulfur atom in the sulfur source to the molar number of a catalyst metal atom of the catalyst source is 2.0 or more, and wherein the sulfur atom in the sulfur source has a vapor-phase concentration of 0.0001 mol/NL or more in the heating zone.

As discussed in the present specification at page 21, line 18 to 22, line 11, the fiber production process of the present invention employs a largely excess amount of a sulfur compound.

The above characteristic carbon structure of the present invention, that is, an inner layer part having a carbon structure containing a herringbone structure in claim 1, or a center part having a carbon structure containing a shape that carbon layers vertical to the carbon fiber axis are stacked in claim 2, is not disclosed or suggested in Komatsu et al at all.

Komatsu et al disclose that the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament, and are arranged substantially in the form of growth rings as viewed in cross-section of the filament. See col. 3, lines 49-56.

The direction of the carbon structure is essentially different between that of the present invention, in which there is a herringbone structure or in which the carbon layers are vertical to the carbon fiber axis, and that of Komatsu et al, in which the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament.

With respect to the manufacturing process set forth in claim 11 of the present specification, Komatsu et al disclose using a sulfur compound, but the specific amount of sulfur as stated in claim 11 is not used in Komatsu et al.

Applicants believe that this difference of the sulfur amount between the present invention as set forth in claim 11 and Komatsu et al is the reason why the present invention and Komatsu et al have different carbon structures.

Fig. 16 of Komatsu et al is an election micrograph showing a broken portion of a carbon filament of the Komatsu et al invention. However, it is difficult to distinguish the inner layer part and the outer layer part in Fig. 16 of Komatsu et al.

It appears from Figs. 11 and 12 of Komatsu et al that the carbon layers are arranged in parallel with the longitudinal axis of the filament, and not in a herringbone structure of claim 1 of the present application, and not in the form of carbon layers vertical to the carbon fiber axis according to claim 2 of the present application.

Thus, the structure and the manufacturing process are essentially different between the present invention and Komatsu et al.

Therefore, Komatsu et al never disclose or suggest the subject matter of the present invention.

In view of the above, applicants submit that Komatsu et al do not disclose or render obvious the subject matter of the present invention and, accordingly, request withdrawal of these rejections.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

RESPONSE UNDER 37 C.F.R. § 1.111  
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Respectfully submitted,

*Sheldon I. Landsman*

Sheldon I. Landsman  
Registration No. 25,430

SUGHRUE MION, PLLC  
Telephone: (202) 293-7060  
Facsimile: (202) 293-7860

WASHINGTON OFFICE  
**23373**  
CUSTOMER NUMBER

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